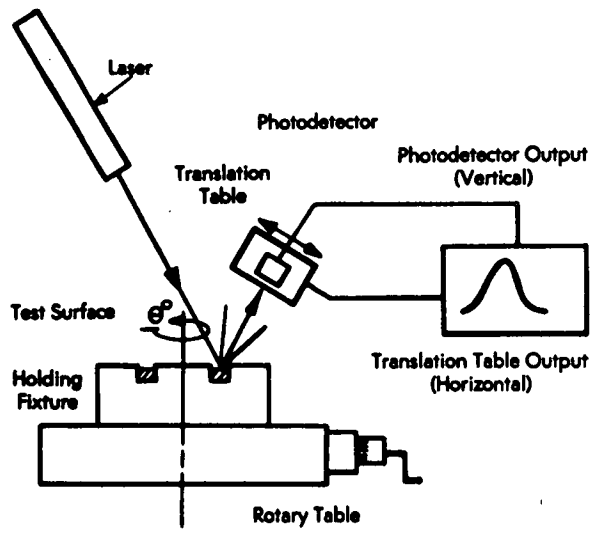
NASA TECH BRIEF

Ames Research Center

Surface Roughness Measured by Optical Signatures

The problem:

To measure the roughness of metal surfaces by a nondestructive means which can reveal irregularities of the order of nanometers.



The solution:

Direct a laser beam at the surface and record the distribution pattern of the intensity of the reflected light to obtain an optical signature for comparison with a calibrated surface.

How it's done:

Coherent light reflected from very smooth surfaces tends to maintain an angle of reflection approximately equal to the angle of incidence, to the extent that reflected light is concentrated in a single direction. As surfaces become rougher, more and more light is diffracted to form intensity distribution profiles (optical signatures) of the reflected light. The reflected coherent waveforms can be projected for immediate visualization, recorded holographically, or manipulated optically for measurement by comparison with the optical signatures of calibrated surfaces. Imperfections can also be detected, for example, the signature of a machined surface with a scratch compared to that of a regularly-patterned machined surface.

The apparatus shown in the diagram was assembled for the purpose of measuring roughness and detecting flaws in valve seats. With a 15-mW He-Ne laser, calibration was made for surfaces with roughnesses of about 50, 100, and 200 nm (2, 4, and 8 μin); a fourth point, corresponding to the width of the laser beam itself ($\approx$635 nm), was made by placing the scanning photometer directly in the laser beam. It was found that the roughness range measurable with this optical system was about 6 to 127 nm.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Ames Research Center
Moffett Field, California 94035
Reference: TSP 74-10118

Patent status:

Inquiries concerning rights for the commercial use of this invention should be addressed to:

NASA Patent Counsel
Mail Code 200-11A
Ames Research Center
Moffett Field, California 94035

(continued overleaf)

Source: Richard J. Salvinski and
Terry V. Roszhart of
TRW Systems Group, TRW, Inc.
under contract to
Ames Research Center
(ARC-10853)